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(54) PRESSURE VESSELS

(71) We, GREER HYDRAULICS, INC., a corporation organised under the laws of the State of New York, United States of America, of 5930 West Jefferson Blvd., Los Angeles, California 90016, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to pressure vessels of the type having a rigid casing with a deformable separator therein in the form of a bladder separating two chambers for fluid. When the pressure vessel is used as a pressure accumulator, one such chamber is charged with gas under pressure and the other is charged with oil under pressure.

In the forming of a pressure vessel of the above type, where the vessel comprises a casing of rigid material having one end closed with an oil port defined in such closed end, and the other end defining an open mouth which is closed by a separate plug, where the plug has to be machined and secured in the open mouth of the casing as by welding or by spinning or rolling the open mouth of the casing over the periphery of the plug or by similar means, the cost of manufacture is considerable.

According to the invention there is provided a method of forming a pressure vessel of the type having a deformable separator therein in the form of a bladder having an enlarged diameter open mouth and a closed end, which comprises the steps of forming a first shell portion with a cylindrical body having a mouth at one end and a closed portion at the other end, said closed portion having a passageway therethrough, inserting one end of a cylindrical sleeve having the enlarged diameter mouth of the bladded bonded thereto, into the mouth of the cylindrical body of the firt shell portion and securing the mouth of the first shell portion to the adjacent portion of the cylindrical sleeve and thereupon deforming the other end of the cylindrical sleeve by forcing such other end inwardly to close such other end of the sleeve.

Also according to the invention there is provided a pressure vessel formed by the said method and comprising a first shell portion having a cylindrical body with an enlarged diameter mouth and a hemispherical closed end portion, said end portion having an axial passageway therethrough, a second shell portion closed at one end and having a mouth at its other end having a portion of smaller diameter than the mouth of the first shell portion so that it may fit therein, means securing the mouth of the first shell portion to the adjacent portion of the mouth of the second shel portion, a bladder of deformable material positioned in said first shell portion, said bladder having an enlarged diameter mouth at one end and being closed at the other end, the mouth of said bladder being bonded to the edge of the second shell portion positioned in the mouth of the first shell portion.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:–

Figure 1 is a longitudinal sectional view of a pressure accumulator with parts broken away;

Figure 2 is a detail longitudinal sectional view on a greatly enlarged scale of the embodiment of Figure 1;

Figure 3 is a fragmentary detail view of another embodiment of the invention; and

Figure 4 is a longitudinal sectional view with parts broken away of another embodiment of the invention.

Referring now to the drawings, in the embodiment shown in Figures 1 and 2, the accumulator comprises a pair of shell por-

tions 11 and 12, the former mounting a deformable separator 13.

The shell portion 11 is formed from a cylindrical member or sleeve 15 open at both ends as shown in broken lines in Figure 1. The sleeve 15 is formed with a reduced outer diameter at one end as at 16, defining an abutment shoulder 17 which is beveled as shown. The free end of portion 16 has an annular lip 18 extending longitudinally from its inner periphery to which is secured as by molding the thickened rim 20 of the separator 13. The separator preferably is an elongated deformable bladder of resilient material such as natural or synthetic rubber having like characteristics.

After the bladder 13 is molded to the open sleeve 15, in the next step of manufacture, the reduced diameter portion 16 of shell portion 11 is then inserted into the shell portion 12, which is in the form of an elongated cylindrical member having an open mouth 24 and a closed hemispherical end portion 25 which has a plurality of perforations 26 defining .;uid passageways arranged around the axial end portion thereof. An outlet fitting 27 having a bore 28 therethrough is secured as by welding at 29' to the hemispherical end portion 25. The shell portion 12 may be formed in conventional manner as by deep drawing.

It is to be noted that the reduced diameter portion 16 of sleeve portion 15 is inserted into the open mouth 24 of the shell portion 12 until the inner edge 29 of the beveled should 17 abuts against the inner periphery 31 of the mouth 24 which is also beveled, the opposed beveled surfaces defining an annular V-groove which receives welding material as at 32 to retain the portions 11 and 12 in fixed position and to define a seal.

Thereupon, the open end 19 of the sleeve 15 is deformed inwardly either by being spun closed in conventional manner, or hot formed in a press to define a hemispherical end 21 for the shell portion 11.

In the embodiment shown in Figures 1 and 2, the open end 19 of the sleeve 15 is squeezed together as at 22 as shown in full lines, by the forming process so that a gas-tight seal will be formed.

In order that the gas chamber A of the accumulator may be pressurized, the open end 19 of the sleeve 15 is spun closed in a pressurized chamber. Thus, gas under pressure will be entrapped in the bladder 13 and the associated shell portion 11, the hemispherical end 21 thus formed, defining the end of the gas chamber A of the pressure accumulator.

If desired, the open end 19 of sleeve 15 may be closed as at 22 as previously described, but not in a pressurized chamber. Thereupon, the end 22 can then be drilled and tapped as shown in Figure 3 to receive a conventional gas charging valve 23 by means of which the bladder 13 may be charged with gas under pressure.

The embodiment shown in Figure 4 is similar to the embodiment shown in Figures 1 and 2 and corresponding elements have the same reference numerals primed.

In this embodiment, the sleeve 15' has one end 33 thereof inclined inwardly to define an annular supporting flange to which the thickened rim 20' of the bladder 13' is molded. Thereupon, the sleeve 15' with the bladder 13' secured thereto is inserted into the open mouth 24' of shell portion 12' which may be identical to shell portion 12 shown in Figure 1. The inner diameter of shell portion 12' adjacent its mouth and the outer diameter of sleeve 15' are such that the sleeve 15' will be retained in the mouth 24' of shell portion 12' by force fit and the outer portion of sleeve 15' will protrude from the mouth 24' of shell portion 12'. The sleeve 15' and the shell portion 12' are secured together as by welding at 32'.

Thereupon, the end 19' of the shell 15' may be spun closed in a pressurized chamber so that when the end 19' is squeezed together to seal such end as at 22' gas under pressure will be entrapped in the bladder 13' and the sleeve 15' which would thus have a hemispherical end portion 21'.

It is also within the scope of the invention to close the end 19' by either hot forming in a press or by spinning without charging the bladder with gas under pressure and thereupon the closed end 22' may be drilled and tapped as previously described with respect to the embodiment of Figure 3 to receive a conventional gas charging valve (not shown) as previously described.

With the process above described it is apparent that a pressure accumulator may be formed in a relatively simple manner with a minimum number of components. By reason of the fact tha the sleeve portion 15 and 15', shown in Figures 1 and 4, not only serves as the support for the bladder, but also defines the closed end 21, 21' of the gas chamber, there is no need to have a separate end closure plug or member to close the end of the sleeve portion 15,15'. As a result, the cost of manufacture is reduced greatly.

WHAT WE CLAIM IS:—

1. A method of forming a pressure vessel of the type having a deformable separator therein in the form of a bladder having an enlarged diameter open mouth and a closed end, which comprises the steps of forming a first shell portion with a cylindrical body having a mouth at one end and a closed portion at the other end, said closed portion having a passageway therethrough, inserting one end of a cylindrical sleeve having the enlarged diameter mouth of the bladder bonded thereto, into the mouth of

the cylindrical body of the first shell portion and securing the mouth of the first shell portion to the adjacent portion of the cylindrical sleeve and thereupon deforming the other end of the cylindrical sleeve by forcing such other end inwardly to close such other end of the sleeve.

2. A method according to claim 1 in which the other end of the sleeve is deformed inwardly in a pressurized chamber so that when said end of the sleeve is closed, gas under pressure will be confined in the gas chamber defined by the bladder and the closed end of the sleeve.

3. A method according to claim 1 in which after the other end of the sleeve is closed, the axial portion of the closed end is drilled and tapped to receive a gas charging valve.

4. A method according to any of claims 1 to 3, in which the other end of the sleeve is closed by spinning.

5. A method according to any of claims 1 to 3 in which the other end of the sleeve is closed by being hot formed in a press.

6. A method according to any of the precedivg claims in which the bladder is formeduin a mold integrally with the second shell portion so that the rim of the bladder will be bonded to the inner edge of said second shell portion.

7. A pressure vessel formed by a method according to any of claims 1 to 6 and comprising a first shell portion having a cylindrical body with an enlarged diameter mouth and a hemispherical closed end portion, said end portion having an axial passageway therethrough, a second shell portion closed at one end and having a mouth at its other end having a portion of smaller diameter than the mouth of the first shell portion so that it may fit therein, means securing the mouth of the first shell portion to the adjacent portion of the mouth of the second shell portion, a bladder of deformable material positioned in said first shell portion, said bladder having an enlarged diameter mouth at one end and being closed at the other end, the mouth of said bladder being bonded to the edge of the second shell portion positioned in the mouth of the first shell portion.

8. A pressure vessel according to claim 7 in which the closed end of the second shell portion is substantially hemispherical.

9. A pressure vessel according to claim 7 or 8 as appendant to claim 3 in which the closed end of the second shell portion has an axial port, and a gas charging valve is secured in said axial port.

10. A pressure vessel according to any of claims 7 to 9, in which a fitting having an axial bore therethrough is secured to the closed end of the first shell portion, said axial bore being aligned with the axial passageway in the closed end of the first shell portion.

11. A pressure vessel according to any of claims 7 to 10 in which the end of the second shell portion to which the mouth of the bladder is bonded has a reduced outer diameter defining an annular shoulder, said annular shoulder having a portion abutting against the inner periphery of the mouth of the first shell portion, said abutting portions being secured togl ther.

12. A pressure vessel according to claim 11 in which the annular shoulder and the adjacent end of the mouth of the first shell portion are beveled to define a V-groove and welding material is positioned in said V-groove to secure said shell portions together.

13. A pressure vessel according to claim 11 or 12 in which the reduced outer diameter portion of the end of the second shell portion has a longitudinally extending annular lip on its inner periphery and the mouth of the bladder has a thickened rim portion bonded to said annular lip.

14. A pressure vessel according to any of claims 7 to 10 in which the portion of the second shell portion positioned in the mouth of the first shell portion is force-fitted therein and the inner edge of said second shell portion is inclined inwardly to define an annular supporting flange and the mouth of the bladder has a thickened rim bonded to the annular supporting flange.

15. A method of making a pressure vessel substantially as hereinbefore described with reference to Figures 1 and 2 or Figure 3 or Figure 4 of the accompanying drawings.

16. A pressure vessel substantially as hereinbefore described with reference to Figures 1 and 2, or Figure 3 or Figure 4 of the accompanying drawings.

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1531612 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1

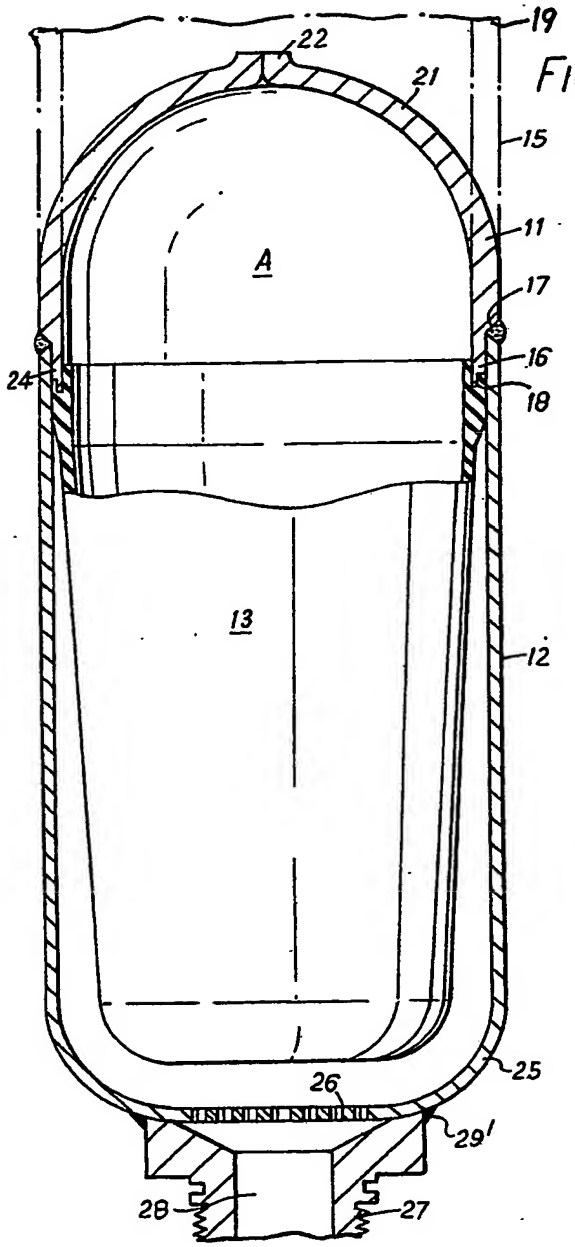
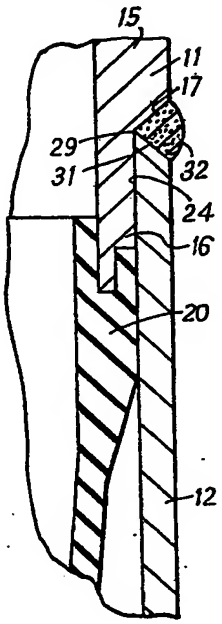


FIG. 2



1531612 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG. 3

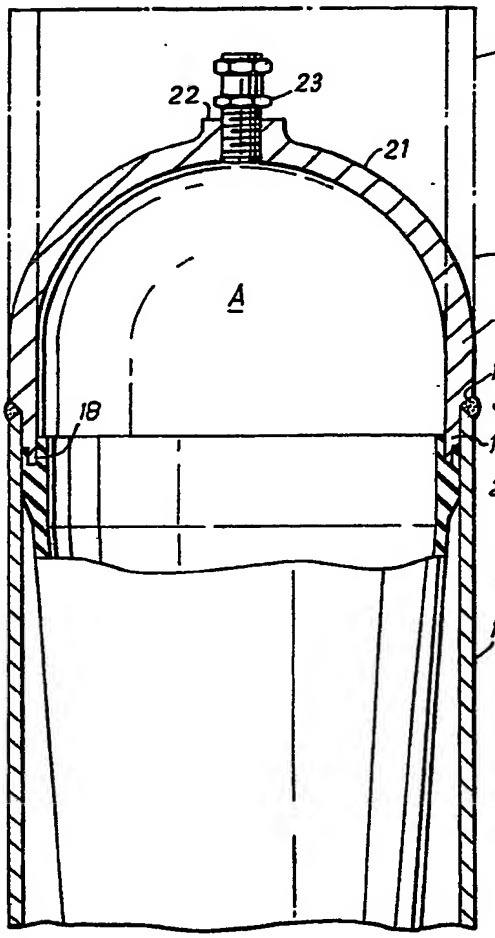


FIG. 4